

REMARKS/ARGUMENTS

Reconsideration of this application is requested. Claims 1-9 and 11-16 are in the case.

I. THE ANTICIPATION REJECTION

It is noted, with appreciation, that the anticipation rejection of claims 1-9 and 11-16 over Sunley *et al.*, Catalysis Today 58 (2000) 293-307 (Sunley) has been withdrawn.

II. THE OBVIOUSNESS REJECTION

Claims 1-9 and 11-16 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Sunley. The Action asserts that, in view of Sunley, it would have been obvious to the skilled artisan to increase the molar ratio of promoter to iridium so as to improve the carbonylation rate. This is not correct. The rejection is respectfully traversed.

The invention provides a process for the production of acetic acid. The process comprises carbonylating methanol and/or a reactive derivative thereof selected from methyl acetate, dimethyl ether and methyl iodide with carbon monoxide in at least one carbonylation reaction zone containing a liquid reaction composition comprising an iridium carbonylation catalyst, methyl iodide co-catalyst, a finite concentration of water, acetic acid, methyl acetate, at least one promoter selected from ruthenium, osmium and rhenium and at least one catalyst system stabilizer selected from indium, cadmium, mercury, gallium and zinc. The molar ratio of iridium : promoter : stabilizer in the liquid reaction composition is maintained in the range 1 : (>2 to 15) : (0.25 to 12).

Processes employing iridium as the carbonylation catalyst typically employ at least one of Ru, Os or Re. The function of Ru/Os/Re is to provide an enhancement in the carbonylation rate over that achieved by iridium alone. Such rates may be improved further by increasing the amount of Ru/Os/Re with respect to iridium (specification, page 1, lines 16-18).

However, a consequence of such elevated Ru, Os or Re : iridium ratios is an increased tendency for precipitation of catalyst and promoter metals to occur (specification, page 1, lines 18-20). A "high" Ru/Os/Re concentration is a ratio of Ru/Os/Re to iridium of greater than 2 : 1. Precipitation of the catalyst system in such processes is disadvantageous, not least because it results in the loss of expensive catalyst and promoter metals.

The technical problem faced by the present inventors was to reduce catalyst precipitation at high Ru/Os/Re : iridium molar ratios (i.e. greater than 2 : 1) in the iridium-catalysed carbonylation of methanol and/or reactive derivative thereof. The presently claimed invention solves this problem.

According to the present invention, the problem outlined above is solved by employing a defined amount of a component selected from indium, cadmium, gallium, mercury and zinc. It is clear from Table 1 (specification, page 12) that the precipitation problem has been solved because in Table 1, in Expt A where a high concentration of promoter to iridium is used (6 : 1) and no stabiliser is present, precipitation of the Ir/Ru occurs. However, in Examples 1, 2 and 3, in which a stabilizer of the invention is added to the Ir/Ru system, precipitation of Ir/Ru is prevented. This is surprising, and could not

have been predicted by one of ordinary skill, as of the filing date of the present application, based on Sunley.

Sunley relates to the carbonylation of methanol employing an iridium catalyst (the Cativa process). Sunley discusses the benefits of the Cativa process over the conventional Monsanto (rhodium-catalysed) methanol carbonylation process (page 293, col. 2, lines 9-14; page 306, "Conclusion"). Sunley describes the use of promoters to enhance the performance of the iridium catalyst in the Cativa process for the production of acetic acid. According to Sunley, the promoters fall into two distinct groups: simple iodide complexes of zinc, cadmium, mercury, gallium and indium; and carbonyl complexes of tungsten, rhenium, ruthenium and osmium (page 299, col. 2, 3rd paragraph). Sunley further states that combinations of promoters from these distinct groups may be employed (page 299, col. 2, last line – page 200, col. 1, 1st line).

However, Sunley does not disclose or suggest use of a catalyst system comprising In, Cd, Hg, Ga or Zn, in addition to an Ir-catalyst and a Ru/Os/Re-promoter wherein the molar ratio of Ru:Ir is greater than 2:1, as presently claimed. In the Experiments which do employ such promoters, the molar ratio of Ru:Ir is 1:1 (Sunley, Experiments 13 and 14, Table 2), not greater than 2:1.

The Action refers to paragraph 7.2.4 and Table 4 of Sunley, and states:

"In spite of employing the high molar ratio of promoter to iridium during the carbonylation process in the continuous unit, the sample comprising iridium and a ruthenium promoter from the catalyst recycle stream of the continuous unit has turned out to be a total absence of any precipitates. This is exactly the opposite to the Applicant's assertion. Thus, there is no significant disadvantage using the catalyst at molar ratios of Ru:Ir of greater than 2:1." (Action, page 5).

However, review of paragraph 7.2.4 of Sunley reveals that it actually states:

"A sample" containing the iridium catalyst and a ruthenium promoter was taken from the catalyst recycle stream of the continuous unit".

Sunley does **not** therefore disclose or suggest the molar ratio of Ir : Ru of the sample. Further, there is no indication anywhere in Sunley that the sample referred to in paragraph 7.2.4 is a sample taken from the catalyst recycle stream of one of the experiments set out in Table 4. In fact, the data in Table 4 is merely "selected published data" (paragraph 7.2).

Thus, one of ordinary skill would **not** have concluded that the molar ratio of ruthenium to iridium in the sample referred to in paragraph 7.2.4 of Sunley is greater than 2:1. Contrary to the above-quoted statement in the Action, one of ordinary skill could **not** have concluded, based on Sunley, that there is "no significant disadvantage using a Ru:Ir molar ratio of greater than 2:1".

The Action further states that Sunley discloses that increasing the promoter to iridium molar ratio will improve the rate of carbonylation (Fig. 3 and Table 4] and that, therefore, the skilled person would be motivated to increase the molar ratio of promoter to iridium in the prior art process so as to improve the rate of carbonylation. This is not correct.

Sunley only discloses that increasing the molar ratio of ruthenium to iridium will result in an increase in the carbonylation rate when ruthenium is the only promoter employed (Fig. 3). There is no disclosure or suggestion in Sunley that when the reaction is carried out in the presence of both Ru/Os/Re and In/Cd/Hg/Ga/Zn, increasing the concentration of Ru/Os/Re will result in an increase in the carbonylation

rate. In fact, Sunley discloses that ruthenium, when used alone as a promoter in a molar ratio of Ru:Ir of 5:1, provides a higher carbonylation rate than the combination of indium and ruthenium promoters, or zinc and ruthenium promoters in a molar ratio of total promoters : Ir of 6:1 (Sunley, Table 2).

Thus, based on Sunley, when looking to improve the carbonylation rate of an iridium-catalysed methanol carbonylation reaction, the person of ordinary skill would have simply employed ruthenium as the promoter, and would not have been motivated to employ a combination of promoters, particularly a combination of Ru/Os/Re and In/Cd/Hg/Ga/Zn in a molar ratio of Ir : Ru/Os/Re : In/Cd/Hg/Ga/Zn of 1 : (>2 to 15) : (0.25 to 12) as presently claimed.

In addition, Sunley is not concerned with a different problem to that addressed by the present invention. Thus, Sunley is not concerned with the problem of catalyst system precipitation in Ir-catalyzed, Ru/Os/Rh- promoted carbonylation processes in which high molar ratios of Ir:Ru/Os/Rh are employed. In fact, in the catalyst stability test reported in Sunley, there is stated to have been "a total absence of any precipitates" (Sunley, page 305, col. 1, last paragraph to col. 2, first paragraph). In light of this, when looking to solve the problem of precipitation at molar ratios of Ru:Ir of greater than 2:1 in iridium-catalyzed, ruthenium-promoted carbonylation processes, the person of ordinary skill would **not** have consulted Sunley, since Sunley does not recognize that catalyst precipitation can be a problem at such high ratios. Furthermore, even if the skilled person did consult Sunley (it is believed that that would not have occurred), Sunley contains no suggestion of a solution to the problem of preventing catalyst precipitation.

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Sunley clearly does not give rise to a *prima facie* case of obviousness of the presently claimed invention. Withdrawal of the obviousness rejection is respectfully requested.

Favorable action is awaited.

Respectfully submitted,

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